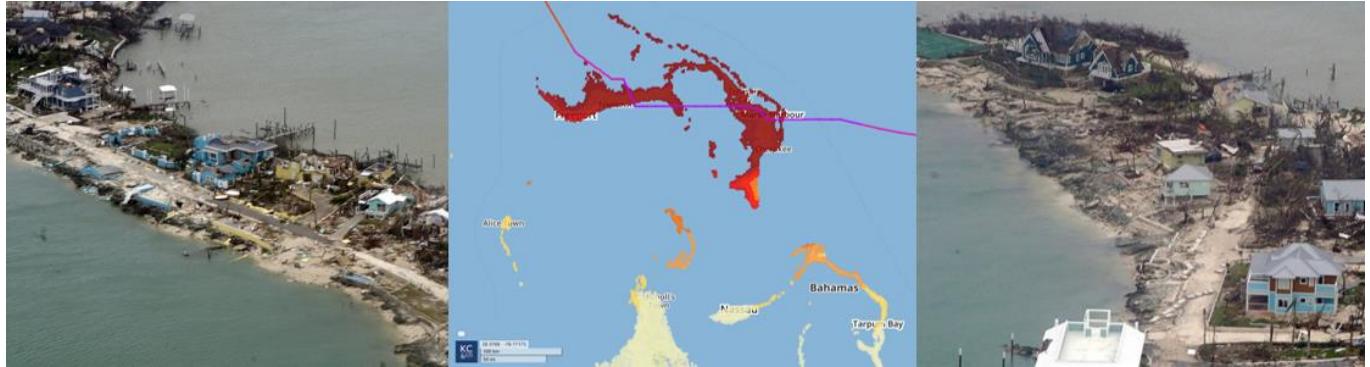


KCC SPECIAL REPORT

Hurricane Dorian Impacts on the Bahamas



September 4, 2019



The Innovation and Technology Leader in Catastrophe Risk Modeling

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Photos displayed on the cover were taken by the US Coast Guard.

Document Date

September 4, 2019

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Executive Summary

The Bahamas experienced the full brunt of the historically intense wind speeds of Hurricane Dorian, and our hearts and prayers go out to the people of the Bahamas. Dorian will go down in history as the worst catastrophe in this region not only due to the highest recorded wind speed in the North Atlantic but also because the storm stalled over Abaco and Grand Bahama Island for over 24 hours. The impacts of Hurricane Dorian on the lives of the people in its path will be felt for many years to come. This special report details the history and impact of this devastating storm.

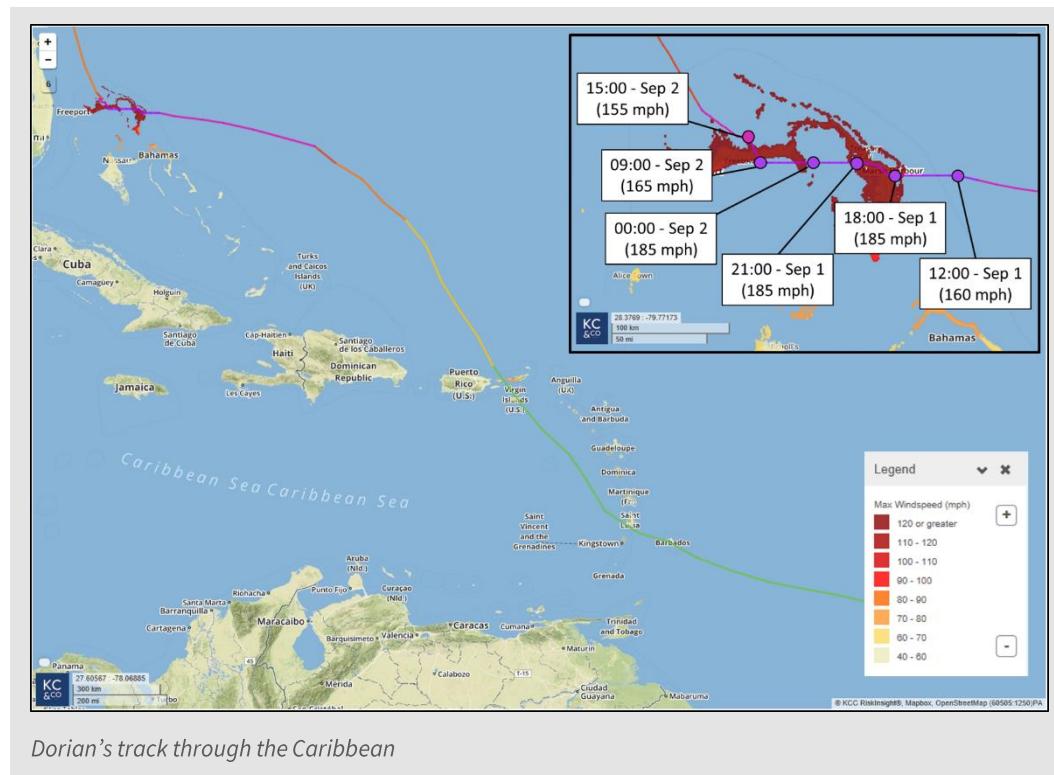
Highlights of Dorian's impacts in the Bahamas:

- Dorian was the fourth Category 5 hurricane to impact the Bahamas in the historical record dating back to 1900, and is the first one with wind speeds of 185 mph.
- Only four other storms have achieved this record intensity in the North Atlantic, and only one of these made landfall.
- Along with record wind speeds, Dorian caused tremendous storm surge flooding with reported surge heights of over 20 feet.
- After Dorian made landfall at Marsh Harbour on Abaco Island, the forward speed decreased to 1 mph and the hurricane moved slowly westward and eventually stalled over Grand Bahama Island, subjecting the region to Category 5 wind speeds for over 24 hours.
- Most of the damage occurred on Abaco and Grand Bahama, although other islands felt the impacts.
- KCC's preliminary estimate of total (insured and uninsured) losses is \$7 billion, including building, contents, and business interruption exposures for commercial, residential, and industrial properties. This estimate does not include infrastructure or auto losses.

Dorian's Meteorological History in the Caribbean

Dorian began as a tropical depression about 1,000 miles east of Trinidad and Tobago and tracked to the northwest, crossing the Lesser Antilles as a tropical storm. Dorian became a hurricane on August 28th just to the north of the US Virgin Islands where it produced 80 mph winds. The storm passed Puerto Rico to the east and continued moving to the northwest as a Category 1 hurricane until August 30th when it began to turn to the west and intensified to a Category 4 storm.

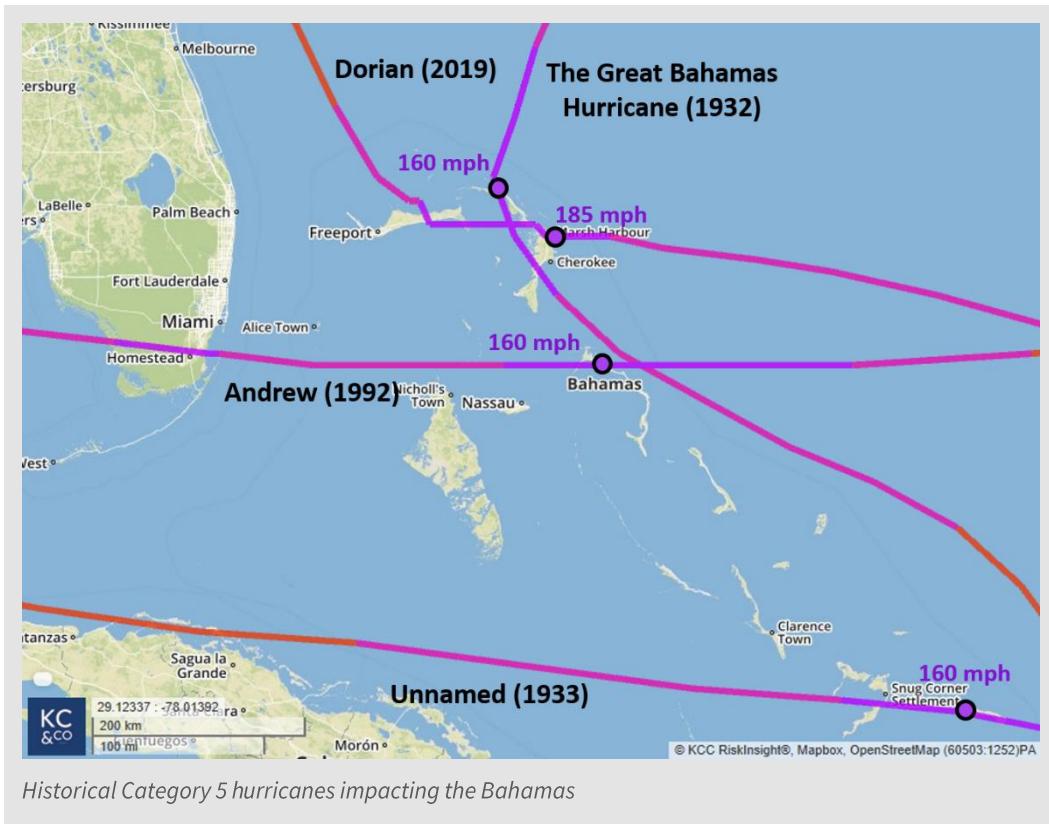
On September 1st as Dorian approached the northwest Bahamas, the storm underwent rapid intensification from a strong Category 4 to a Category 5 storm with historically intense winds of 185 mph. Hurricane Dorian maintained its peak wind speed of 185 mph as it crept over Abaco on the evening of September 1st, battering the islands for nine hours with winds of an intensity rarely seen anywhere in the Atlantic. As it reached its peak intensity, it also decreased in forward speed, slowing to one mph and eventually stalling over Grand Bahama Island. Altogether, Dorian spent over 24 hours directly impacting the Bahamas as a Category 5 storm.

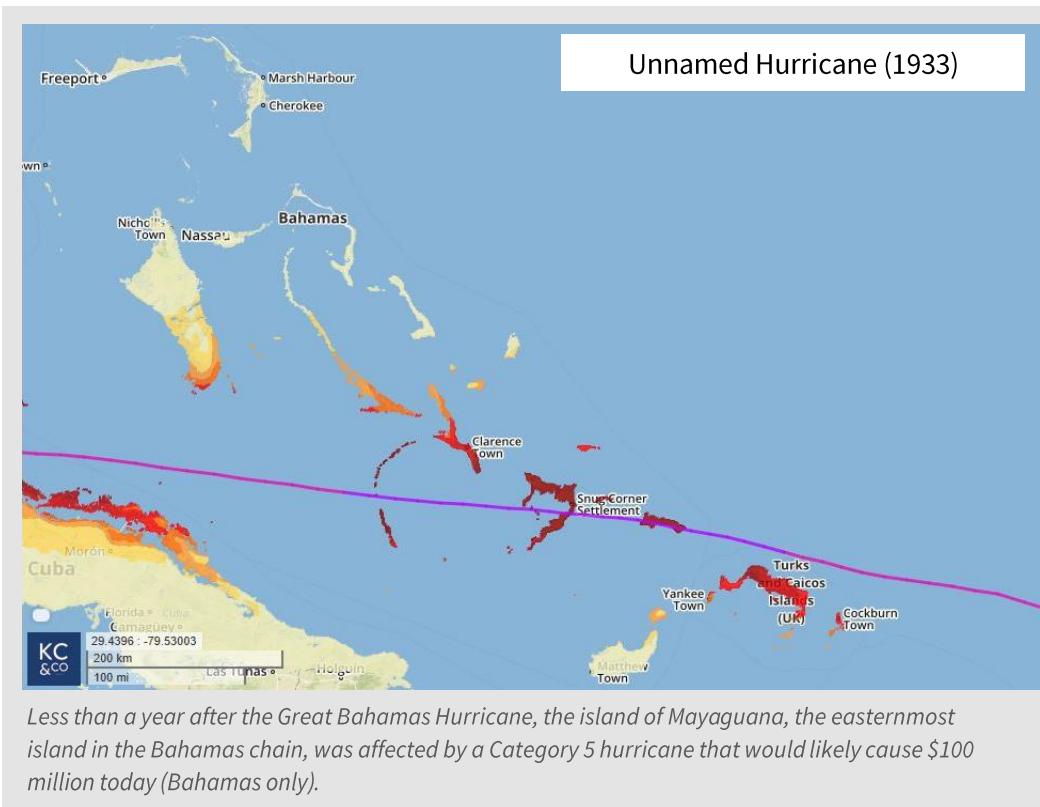
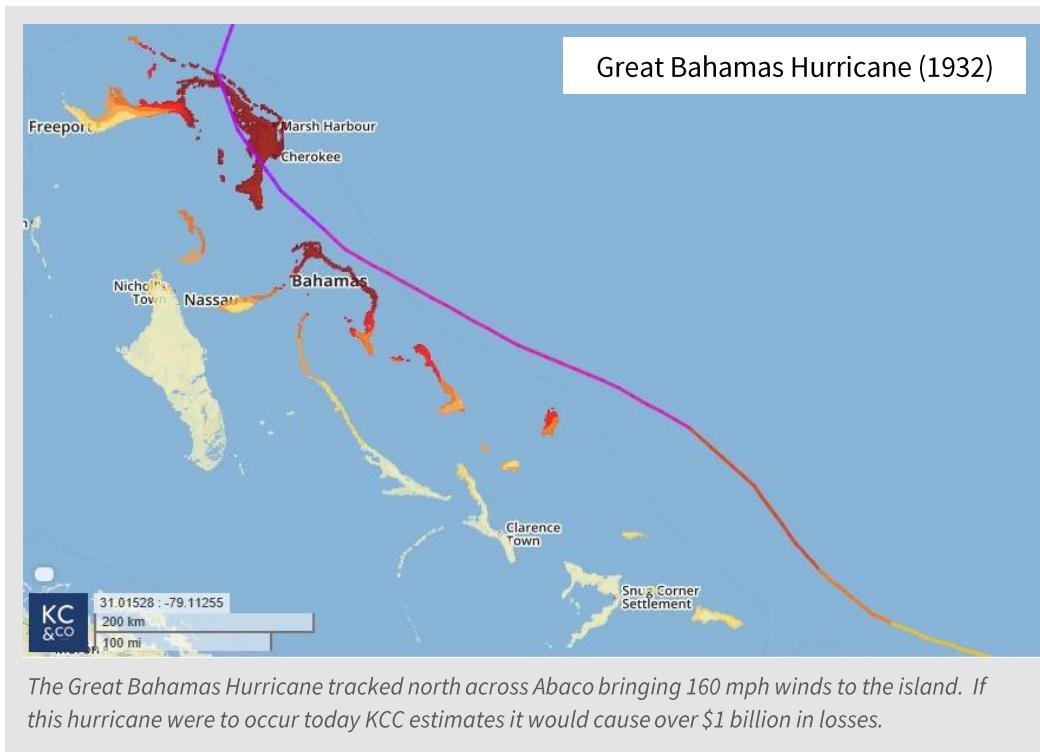


Historical Perspective

On September 1st, when Hurricane Dorian, already a strong Category 4 storm, rapidly intensified and reached a peak sustained wind speed of 185 mph, it joined a very select group of the most intense hurricanes ever recorded. Only four other North Atlantic storms in the historical record have attained this wind speed – Labor Day (1935), Allen (1980), Gilbert (1988) and Wilma (2005), but only the Labor Day Hurricane impacted land with wind speeds of 185 mph.

Located in the warm waters of the North Atlantic Ocean just north of Cuba and Hispaniola, the Bahamas often experience tropical cyclones. The island chain has been impacted by nearly 60 hurricanes since 1900. The country is not a stranger to extremely powerful storms having been in the path of three other Category 5 hurricanes in the historical record, although none of these attained Dorian's intensity.







In 1992, before barreling through Homestead, FL, Hurricane Andrew made landfall at Gregory Town in the Bahamas with wind speeds over 160 mph. KCC estimates this storm would cause over \$1 billion in loss in the Bahamas if it happened today.

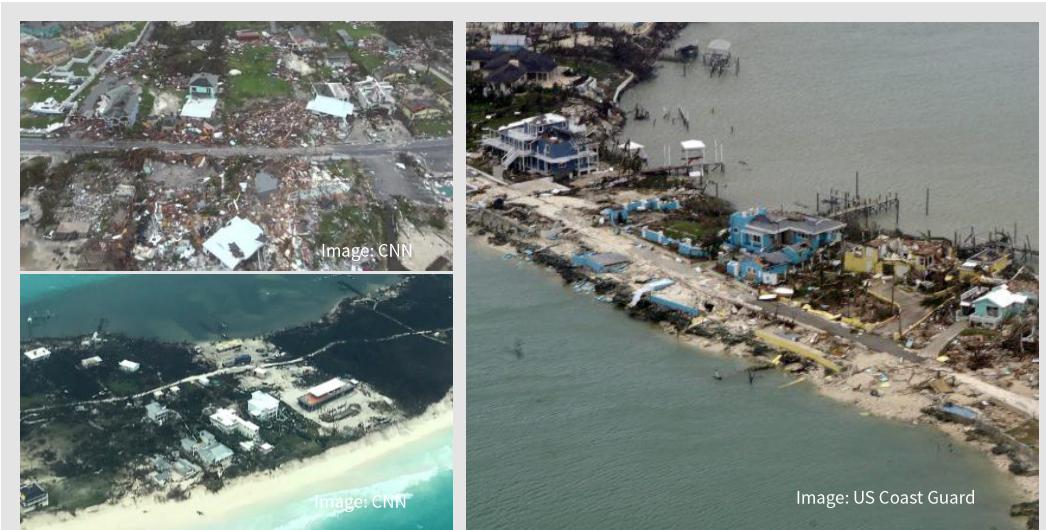
Dorian's Impacts on the Bahamas

Abaco

KCC's high-resolution Caribbean Tropical Cyclone Reference Model shows that the highest wind speeds over land in Hurricane Dorian were at Elbow Cay and Marsh Harbour where the storm made landfall.

Abaco experienced Hurricane Dorian at its peak intensity and a prolonged period of exposure to 185 mph winds. Winds of this magnitude cause major structural damage to wood frame and masonry structures. The building stock in Bahama is predominantly masonry buildings with wood-frame roofs. As a result, most residential structures and other buildings on Abaco suffered total damage from wind.

Along with the wind damage, Abaco experienced storm surge flooding levels of up to 20 feet on parts of the island. Between the inundation from storm surge and record high winds, a near total loss of property is expected for Marsh Harbour and the surrounding communities.



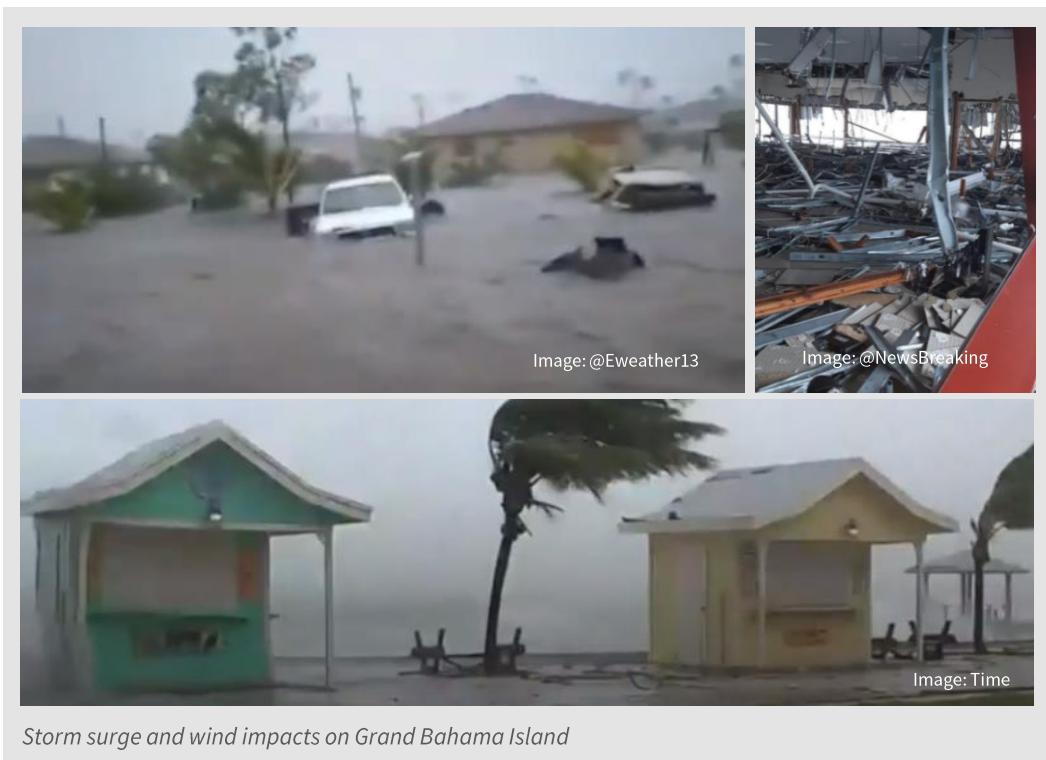
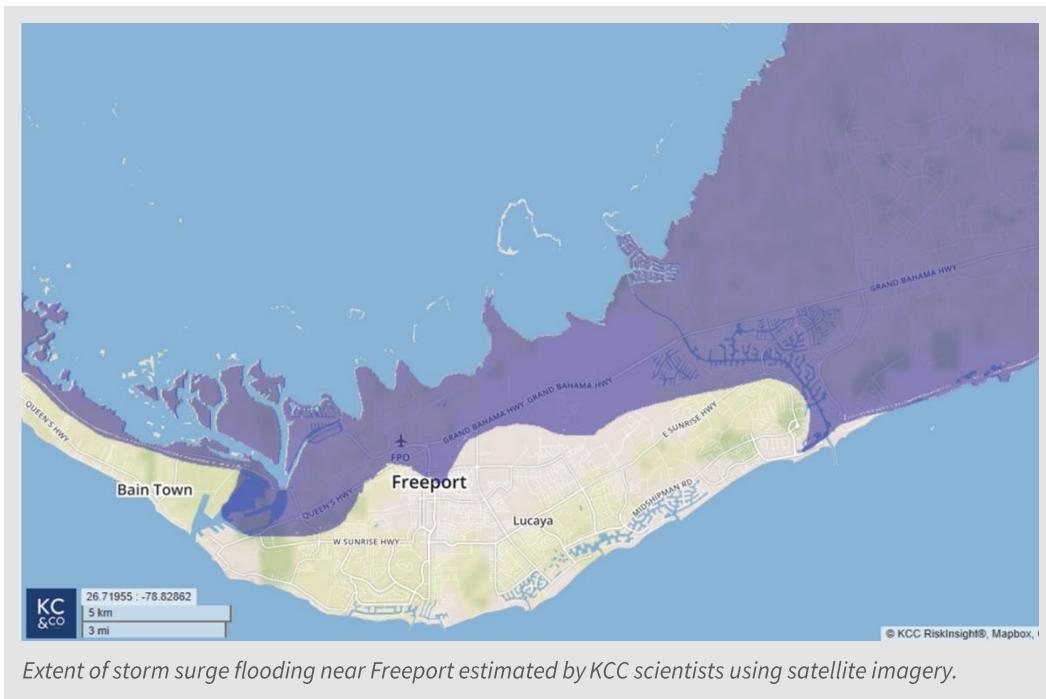
Damage from high winds and storm surge in Abaco

Grand Bahama Island

Dorian also brought 185 mph winds to Grand Bahama Island, but its track turned northward before it reached Freeport, the most populated area on the island. As a result, Freeport experienced sustained wind speeds closer to 120 mph with higher gusts. These wind speeds are sufficient to cause extreme damage to roof covering and decking.

Storm surge contributed relatively more to the loss in Freeport and other Grand Bahama locations that were outside of the hurricane eyewall and experienced lower wind speeds. As Dorian stalled over Grand Bahama on September 2nd, it pushed a storm surge of nearly 20 feet onto the northern side of the island. Much of downtown Freeport was also flooded along with the airport.

KCC scientists estimated the extent of storm surge flooding using satellite imagery compiled by ICEYE. This technology penetrates cloud cover to provide near real-time surface conditions. In the image below, inundated areas are shown in dark blue.



New Providence Island

The most populous island in the Bahamas is New Providence which includes the capital city of Nassau. The island was impacted by tropical storm force winds which cause relatively minor roof damage when compared to the damage closer to the hurricane center. Widespread street flooding was reported on the island from a combination of 6 to 10 inches of rainfall and storm surge. Estimated inundation in Nassau was generally between 1 to 3 feet with higher values confined to the coastline.

Summary

Dorian will go into the history books as the hurricane causing the most intense wind speeds over land and for the longest duration. While the total losses—an estimated \$7 billion—are catastrophic, particularly for Abaco, Dorian’s track was not the worst-case scenario for the Bahamas. New Providence, the most populated island, was spared the worst of Dorian’s wind speeds and storm surge.

